SSGIC
Wildland Fire Susceptibility Index (WFSI) Process Development
Contractor – Don Carlton, Fire Program Solutions, LLC
Feb. 27, 2002 – Porterville, CA

Meeting Notes

Objectives:
Don Carlton was contracted to assist the SSGIC in developing processes to implement the WFSI model over the SSGIC analysis area. The specific goals of the meeting were to:

1. Review FlamMap outputs, fine tune parameters for final runs, and reconsider need to develop optional data layers for crown height, crown base height, crown bulk density.
2. Define the process for and identify problems associated with linking ignition data to weather data to assign each historical ignition to a weather percentile category based on Spread Component (SC).
3. Define procedures to develop regression equations to predict Final Fire Size (FFS) from FlamMap Rate Of Spread (ROS) outputs.

Notes on which action needs to be taken are in **bold** text. The next general meeting of SSGIC will be on April 17, 2002 at which time the WFSI is expected to be complete.

Participants:

Don Carlton, dcarlton1@aol.com, Contractor from Fire Program Solutions, LLC
Corky Conover, corky_conover@nps.gov, Sequoia & Kings Canyon National Parks
Chuck Dickson, cdickson@co.kern.ca.us, Kern County Fire Dept.
Heidi Hosler, hhosler@fs.fed.us, Sequoia National Forest
Pat Lineback, pat_lineback@nps.gov, Sequoia & Kings Canyon National Parks
Rich Olson, rolson@co.kern.ca.us, Kern County Fire Dept.
Tony Sarzotti, asarzotti@ca.blm.gov, Bakersfield Bureau of Land Management
Brent Skaggs, bskaggs@fs.fed.us, Sequoia National Forest
Diane Tavis, dsutphentravis@fs.fed.us, Sequoia National Forest
Anne Birkholz, anne_birkholz@nps.gov, SSGIC

Background:
FOA (Fire Occurrence Area) – Anne Birkholz
Review of the FOA process and raster analysis in general. Don noted that 2200 meters was selected as the radius of the neighborhood analysis to ensure that the analysis reached adjacent ignition points where the accuracy of ignition point locations is limited at the time of collection to a Public Land Survey section.

FlamMap – Brent Skaggs
Overview of the development of weather data file inputs to FlamMap – Brent reviewed his evaluation of weather station data and his and Corky's decision to implement one weather influence zone for the SSGIC. Variation in the weather data for fuel moistures and wind speed between stations did not justify implementing multiple weather influence zones. They selected the Ash Mountain station as the most representative station and will apply it across the entire analysis area. Use weather data for days of fire season only (May 1 – Oct. 31).

Model outputs – Participants evaluated FlamMap outputs of the Kern watershed. Available were the ROS for Extreme and Moderate weather percentile categories and Flame Length. Discussion centered on the high proportion of the area displayed as red or a "high" ROS and the minimal difference displayed between the Extreme and Moderate outputs. To resolve the display issues, there was agreement that more categories need to be displayed to improve discrimination. Heidi supplied an updated map displaying 10 ROS categories. This was an improvement, but highlighted the need to look more closely at the data. ROS's above 200 chains/hour are questionable. Don suggested using Behave to calculate ROS for selected cells to verify the FlamMap outputs.

The group discussed whether to pursue the three optional FlamMap source data layers of Crown Bulk Density, Crown Height, and Crown Base Height that allow the model to describe crown fires. Without these spatial data layers, the model uses user supplied constants that can lead to unrealistic crown fire behavior. This may be a reason for the high ROS's in the Kern outputs noted above. Don suggested that without these layers it would be best to suppress crown fire modeling in FlamMap. This is accomplished by supplying a Crown Base Height constant slightly less than the Crown Height constant, and a low Crown Bulk Density constant.

It was agreed that 1) for the current analysis we will not have time to pursue these additional layers, and 2) that in the long term we should continue to pursue the options we have for acquiring this data. Included are:

1. FS - these layers were already developed for the Sierra Framework utilizing Forest Inventory and Analysis (FIA) datasets and should be obtainable**. Anne will acquire this data from Ralph Warbington of the USFS**.
2. BLM, CDF and Kern Co. - acquire the procedures and decision rules utilized by the Sierra Framework, obtain the FIA plot data for these lands, and evaluate the potential for implementation across these areas.
3. BLM Case Mountain area - determine if the new fuels data obtained by the BLM for the Case Mountain area includes of Crown Bulk Density, Crown Height, and Crown Base Height**. Tony will check on whether this data is present**.
4. NPS and Wilderness areas (no FIA plot data) – determine the validity of extrapolation from the Sierra Framework assignments.
5. NPS – determine if we can utilize existing datasets to predict the data. Mark Finney is a contact for assistance in developing the Crown Bulk Density layer.

Each agency was asked how important it was to them to model crown fires. They responded s follows:

Forest Service – Important
Kern Co. – Probably not
CDF – Not represented at the meeting; Kern Co. thought probably not
BLM - Only for Case Mountain area
SEKI – Not really, except perhaps near boundaries

Opportunities for fine tuning FlamMap include:

1. **Use PCHA application to edit "bad" weather data records.**
2. **Download and use Behave 1.0.0 (www.fire.org) to calculate ROS for selected cells to verify that we are getting correct outputs from FlamMap.**
3. **Consider using Burn Index instead of SC to improve stratification of FlamMap outputs.**
4. **Display more classes in the ROS maps.**
5. **Given that we will not have the 3 optional crown data layers, suppress modeling of crown fires in FlamMap. To suppress crown fires in the model, provide FlamMap with a Crown Base Height just under the Crown Height and a low Crown Bulk Density.**
6. **Document the procedures we used.**

Don Carlton noted that developing custom fuel models is important, especially, if we begin evaluating "after treatment" scenarios. The standard Anderson fuel models are too limiting to describe target fuel types after treatment.

WFSI –Don Carlton and Anne Birkholz
Review of the flow of information into the WFSI model. For each 30 meter cell in the analysis area, the following data needs to be acquired:

1. From FOA – Identification of the FOA classes based on the probability of an ignition, acres in each FOA class, and the number of historical ignitions in each FOA class.
2. From weather data linked to ignition data – assign to each historical ignition the weather percentile category of its ignition date based on SC.
3. From FlamMap – Predicted ROS for each 30m cell in each weather percentile category.

Don Carlton walked through the computations involved in the WFSI. This process describes what happens in each 30m cell in the analysis area to assign a WFSI value. He cautioned that, since the calculation of the WFSI in each cell assumes that every cell in the FOA is the same as the current cell (and this is not true), it can calculate WFSI values greater the 1. WFSI does not predict exactly what happens in each cell, rather it ordinates the values across a relative "value" scale. The table below reviews the calculations:

Calculation of WFSI Value for a Single Cell *

* Values are not actual data, but designed for ease of calculation.
Example assumes a 20,000 acre FOA class with 50 historical fires in it.
The calculated probability of ignition for this FOA class is 2.5 ignitions/1,000 ac/yr

	Weather Percentile Category				
	Low	Moderate	High	Extreme	
Weather percentile catagories (by definition)	0-15	16-89	90-97	98-100	**Total**
Percent of days in each category (by subtraction of above)	15	74	8	3	**100**
Range of Spread Components in each weather category as predicted by Fire Flamily Plus	0-9	10-19	20-39	40+	
Percent of ignitions that occurred in each weather category based on ignition date link to weather data	10	80	4	6	**100**
Predicted number of ignitions based on percentiles from above row	5	40	2	3	**50**
Average ROS from FlamMap (chains/hour)	2	5	10	20	
Final Fire Size based on ROS above and regression equations (acres)	4	25	200	400	**629**
Predicted annual acres burned (number of ignitions above x FFS)	20	1000	400	1200	**2620**
Probability of an acre burning (Predicted annual acres burned/acres in FOA class)	0.001	0.05	0.02	0.06	**0.131**

WFSI for a cell is the Sum of the probabilities of an acre burning across all weather percentile categories

Processes Defined to continue WFSI calculations:

1. Review FlamMap outputs, fine tune parameters for final runs, and reconsider need to develop optional data layers for crown height, crown base height, crown bulk density.

   Addressed under FlamMap background above.

2. Define the process for and identify problems associated with linking ignition data to weather data to assign each historical ignition to a weather percentile category based on SC.

   Don Carlton reviewed his spreadsheet format for ignition data. It contains the entire ignition dataset with ignition dates in one table and the Fire Family Plus calculated SC for each day in another table. It then assigns to each ignition the SC of the date of the fire and calculates the frequency of ignitions in each weather percentile category. He used the PCHA (Personal Computer Historic Analysis) USFS application to export ignition data to the Excel spreadsheet. We will use this as a template for our data. **Anne will finish assembling this data.**

3. Define procedures to develop regression equations to predict FFS from FlamMap ROS outputs.

   Building the regression equations to predict FFS from the ROS for each cell is the "art" of the WFSI. Each of 3 portions of the regression curve is based on a different sample dataset for low, moderate, and high ROS's.

   At low ROS's, sample fire data comes from Suppression Table 1 in the IIAA module of NFMAS for contained fires. Records with an "*" are escaped fires and these are eliminated from the low ROS dataset. Both FS and BLM use NFMAS and have these datasets**. Diane Travis will pass the FS data on to Tony and he will append the BLM data and direct it to Don Carlton.** This will be used across the entire analysis area. As ROS increases there will be more escaped fires and this determines the breakpoint between low and moderate ROS's.

   To develop the relationship at moderate ROS's, use actual data from escaped fires that have perimeter data over time (day 1 of fire, day 2 of fire, etc.). These can be digital or hardcopy. **Each agency will select several escaped fires for which this data is available. These should be in the range of 1000+ acres, but not necessarily just the really big ones. The data needed for each fire includes acres for each successive perimeter, hours of active burning between successive perimeters, and ROS for each time interval. Be sure to include only time of "active" fire spread, not 24 hours a day. Suggested fires include (but are not limited to):**

BLM/Kern Co. –	**King**
	Manter
	Jacks
FS -	**Stormy**
	Highway
	Coffee
NPS -	**Choke**
	Kaweah
	Buckeye
	Amphitheater

Pass this information to Tony Sarzotti who will assemble it and pass it on to Don Carlton to develop the regression equations.

The third portion of the regression equation is for high ROS's. Prediction of a maximum fire size is necessary to put an upper limit on predicted fire size. It prevents the model from predicting unrealistically large sizes. This is based on expert knowledge and assumes suppression of the fire. **Each agency will provide Tony with an estimate for their agency.**